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M20078X

REGULATED POWER SUPPLIES

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HARRISON LABORATORIES

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CLAIM FOR DAMAGE IN SHIPMENT

This equipment should be tested as soon as it is received. If it fails to operate properly or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition which is to be made of the equipment and arrange for repair or replacement.

SEE WARRANTY NOTICE ON INSIDE BACK COVER

HARRISON LABORATORIES

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3-5-63

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HARRISON LABORATORIES

45 Industrial Road
Berkeley Heights, New Jersey

464-1234
TWX Summit, N.J. 977

Model 865B

Power Supply
Instruction & Operating Manual

MODEL 865B
POWER SUPPLY

SPECIFICATIONS

Input: 105 to 125VAC, 50-440 cycles/sec., single phase

Output: 0 to 40 volts, 0 to 0.5 amps. Constant Voltage or Constant Current

Load Regulation: Constant Voltage--0.01% or 4 mv (whichever is greater) for a 0.5 amp load change.
Constant Current--0.05% or 250μa (whichever is greater) for a 40 volt load change.

Line Regulation: Constant Voltage--0.01% or 4 mv (whichever is greater) from L.L. to H.L.
Constant Current--0.05% or 250μa (whichever is greater) from L.L. to H.L.

Ripple and Noise: Constant Voltage--Less than 200 microvolts rms.
Constant Current--Less than 200 microamps rms.

Maximum Operating Temperature: 50°C

Temperature Coefficient: Less than 2 millivolts per degree Centigrade in Constant Voltage operation.*

Stability: Less than 30 millivolts total drift for 8 hours (after 20 minutes warm-up) at a constant ambient.*

Internal Impedance:
Less than .01 ohms from DC to 100 cycles.
Less than .02 ohms from 100 cycles to 1 Kc.
Less than .5 ohms from 1 Kc to 100 Kc.
Less than 3 ohms from 100 Kc to 1 Mc.

Transient Recovery Time: In constant voltage operation less than 50μsec is required for output voltage recovery to within 10 millivolts of the nominal output voltage following a load change equal to the maximum current rating of the supply. For this measurement the nominal output voltage is defined as the mean between the no load and full load voltages.

* Using precision wire-wound remote programming resistor or rheostat.

Overload Protection: The supply is fully protected against internal damage for any load condition in either constant voltage or constant current operation. In addition, optimum protection for the load device is assured by the continuously adjustable current limit in constant voltage operation and the continuously adjustable voltage limit in constant current operation.

Controls: Both coarse and fine voltage and current controls are provided. The coarse controls make possible continuous adjustment of the output voltage and current over the entire operating range. In addition, mounted on the front panel are the off-on switch, pilot light, and meter switch.

Meters: A single meter and meter switch make possible the monitoring of either output voltage or output current.

Output Terminals: Output power is made available via "five-way" output binding posts on the front panel and a rear panel terminal strip. This rear terminal strip also provides connections for Remote Programming, Remote Sensing, Auto-Series and Auto-Parallel Operation. Power supply output terminals are isolated from the chassis and either the positive or negative terminal may be connected to the chassis through a separate ground terminal located adjacent to the output terminals.

Remote Programming: Remote programming of the supply output voltage at approximately 500 ohms/volt is made available on the rear terminal strip.

Cooling: Convection cooling is employed. The supply has no moving parts.

Size: 7-13/16"W x 5-1/16"H x 8-1/2"D

Weight: 12 pounds

Finish: Light gray front panel with dark gray wrinkle case.

Power Cord: A three wire five foot power cord is provided with each unit.

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OPERATING INSTRUCTIONS

INSPECTION

This instrument was thoroughly tested and inspected before being shipped and is ready for use when received.

After the instrument is unpacked, it should be inspected for damage received in transit. If any shipping damage is found, follow the procedure outlined in "Claim for Damage in Shipment" on the warranty page.

PUTTING THE SUPPLY INTO SERVICE--RACK MOUNTING INSTRUCTIONS

The Model 865B supply can be used in a C-855/865B case or mounted on an R-855/865B rack mounting panel. If the 865B is to be used in conjunction with the rack mounting panel, it is necessary only to remove the top and bottom covers, insert the unit through the panel from the front, turn the top and bottom covers upside down (to clamp unit to the panel) and tighten down cover screws.

CONTROLS AND TERMINALS

The toggle switch near the lower left edge of the front panel controls the power supplied to the equipment from the power line. The indicator lamp beside the switch, when lighted, indicates that AC power is applied to the transformer primary.

Fuse -- The fuseholder is located on the rear of the power supply and contains a two amp 3AG fuse for the protection of the entire instrument. This fuse is not intended to provide the output overload protection. An automatic output overload circuit is used for this purpose and thereby protects the series transistors.

Controls -- The control marked "Voltage Adj." provides a continuous adjustment of the output voltage. A small vernier knob is concentrically mounted with the larger main voltage adjust knob. This fine control permits a fine adjustment of the output voltage and has a 0.5 volt range over the 270° pot rotation. The "Current-Ma." knob permits the maximum output current to be limited to approximately the value indicated on the front panel scale associated with this knob. For a more exact setting of this control the output terminals should be shorted; the ammeter then indicates directly the current limit value.

IMPORTANT: This supply automatically operates as a constant voltage supply when the load is such that it will not exceed the maximum current setting, and it operates as a constant current supply whenever the load current exceeds the "Current-Ma." setting.

TERMINALS

On the front panel are located two output binding posts and a ground terminal. The metallic post designated "GROUND" is the chassis ground and may be connected to the red (+) output binding post or the (-) output binding post as desired. In the rear of the supply (see Figure 1) there are 13 terminals on a barrier strip. The output is designated as (+) or (-) and the sensing leads are marked (-S) and (+S). Note: As the unit is received from the factory the (+S) terminal is connected to the (+) output terminal and the (-S) terminal is connected to the (-) output terminal. These barrier strip connections must be made if local sensing is employed and the output power is to be taken from either the red and black "five-way" terminals on the front of the unit or from the (+) and (-) barrier strip terminals on the rear. Furthermore, terminal A1 must also be connected to the +S terminal--terminals A2, A3, and A4 must be connected together and terminals A6 and A7 must be joined. This is indicated above the terminals and these connections are already made as the unit is received from the factory. Terminals A1, A2, A3, A4, A5, A6, A7, A8, and A9 are used for other modes of operation such as Auto-Parallel, Auto-Series, etc., which will be described later in this instruction manual.

REMOTE PROGRAMMING

One of the most useful functions of this power supply is made possible by its ability to be set

a. at any fixed voltage output between 0 and 40 volts with a maximum allowable current from 0 to 500 ma.

b. at any current output from 0 to 500 ma. with a maximum voltage limit from 0 to 40 volts.

both functions being controllable remotely.

REMOTE VOLTAGE CONTROL

The output voltage of this supply can be changed from a remote location by connecting a variable resistance between +S and A2. Terminal A2 should also be connected to A3. The strap between A4 and A2 should be disconnected. The output voltage of the supply will be 1 volt (±10%) for each 500 ohms of resistance connected between +S and A2. Several methods of remotely controlling the output voltage are as follows:

1. A 25,000 ohm variable resistance can be placed across the programming terminals +S and A2; the output will then be continuously variable from 0 to 40 volts. Note: It is necessary to use a good low temperature coefficient (30 ppm or better) wirewound

variable resistance if stability is important.

2. A single resistor can be used as the programming element, thereby fixing the output voltage at some predetermined value.

3. Several resistors can be connected to a switch so that the voltage can be changed from one predetermined value to another with the assurance that any of the preset values can be accuratly reproduced at a later time. Note: Make sure a shorting type switch is used so that the voltage programming resistor terminals will not be momentarily opened as this would allow the output voltage to exceed 50 volts for this interval.

REMOTE CURRENT CONTROL

Constant current, remote programming is effected by:

1. Removing the rear terminal strap between A6 and A7. This disconnects the internal current control knob located on the front panel.

2. Turn the "Current-Ma." knob on the front panel maximum clockwise.

3. Connect a variable resistance between A6 and A5. It is recommended that a twisted pair of shielded leads be used for the programming leads as shown in Figure 2.

The output current is not a precisely linear function of the programming resistance; however, a good approximate is 2.0 ohms per milliampere. A low temperature coefficient wirewound resistance must be used if stable output is required in an environment having a varying temperature.

REMOTE SENSING

Remote sensing is used to establish a low impedance at the load rather than the output terminals of the power supply. This enables the output voltage to be monitored and controlled at the load terminals which may be some distance away from the supply and by this means the voltage drop occurring in the lead resistance going to the load may be eliminated. To sense the output voltage at a remote location, disconnect -S from (-) on the rear of the unit and reconnect the -S lead to the (-) load terminal at the load. Disconnect the +S from the (+) terminal on the rear of the unit and reconnect the +S terminal the (+) terminal at the load. This is shown by Figure 3 for a supply that is otherwise locally controlled--i.e., both front panel voltage and current control are assumed. There is complete

independence of

1. Voltage control--whether remote or local
2. Current control--whether remote or local, and
3. Sensing--whether remote or local.

Any combination of these may be used as desired.

SERIES OPERATION

Two or more 865B's can be combined in series to obtain a voltage higher than that available from one supply alone, or to obtain a "chain" of regulated voltages. There are several methods by which these supplies can be connected in series. The simplest means consists of placing the output terminals in series, and allowing each supply to be individually controlled by its own front panel control (or remote programming control). This method has the obvious disadvantage that the total output voltage is not continuously adjustable over the entire range by means of one knob. To overcome this shortcoming, the output of two supplies may be connected in series and their output controlled by two ganged remote programming pots. However, this is not very convenient.

Perhaps a better, more convenient method, and one which avoids the use of ganged pots and allows control of the overall voltage from the front panel of one of the supplies, is shown in Figure 4. Figure 4 shows only two supplies connected in series; however, this method may be used to series up to 13 units if required, and one may control the overall voltage with one knob. Only one external resistance (R) is required to series any number of supplies and is approximately equal in value to the maximum resistance of the voltage control knob which is approximately 20,000 ohms for 40 volts output.

Figure 5 shows series operation for three units; however, the idea can be extended to any number in principle, 6 to 7 in practice.

PARALLEL OPERATION

Parallel operation of two low resistance power sources is normally impossible because of the large circulating current which will result from even a small difference in the output voltage of the two sources. However, the 865B has provision for slave operation, wherein one supply (the master unit) controls its own output and that of another supply (the slave unit) whose output terminals are connected in parallel with those of the master supply.

Figure 6 shows the rear connections when two units are paralleled. The master is connected in a normal manner while the slave senses the current in the master.

POWER SUPPLY MEASUREMENTS

When measuring the output impedance, transient response, or ripple of the supply, be sure that the measuring device (differential voltmeter, digital voltmeter, or oscilloscope) is attached directly to the output terminals of the supply as close as possible to the point where the error sensing leads are connected. Make certain that none of the output current flows through any lead lengths in series with the monitoring device, since such lead lengths can easily have an impedance of the same order of magnitude as the supply impedance and thus effectively make the measurement invalid.

When measuring power supply ripple, connect either the positive or negative terminal of the supply to the chassis and ground the scope case to the same point, making certain that the scope case is not also grounded by some other means (such as a three wire power cord). To be doubly certain that the scope is not exhibiting a ripple or transient spike that is actually not coming from the power supply, connect both scope leads simultaneously to the power supply ground terminal; no ripple or transient spike should be visible if the power supply is properly connected to the oscilloscope.

The matter of attaching monitoring devices directly to the binding posts themselves cannot be overstressed; even one inch of #12 bus wire will have a noticeable effect on the measurements, and attaching a clip lead from a voltmeter or scope to another clip lead which is carrying output current and which in turn is connected to the binding post can result in a noticeable difference in the measurements made. One means of insuring an accurate measurement is to plug the load into the end of the five-way binding posts and then connect the voltmeter across the binding posts at the neck of the post. Wire holes are provided in the binding post and if stiff wires are placed through these holes, it is very convenient to sense the output voltage at this point.

MULTIPLE POWER SUPPLY LOADING

When connecting several pieces of equipment to the same power supply, it is imperative that each load have two separate leads brought directly back to the power supply terminals if full advantage is to be taken of the low impedance of the supply and mutual coupling effects between the equipments being powered are to be avoided.

NEGATIVE CURRENT LOADING

Should it be necessary to attach a load to the power supply which would cause positive current to flow into the positive power supply terminal during some portion of the operating conditions, an extra load resistance having a maximum value equal to the output voltage divided by the maximum instantaneous current

which would be pumped into the supply should be connected across the supply terminal. This is necessary in order to insure continuous regulation, since the series regulating resistors must be conducting in the forward direction at all times and no external source should be allowed to add charge to the output capacitor of the power supply.

OVERLOAD PROTECTION CIRCUIT

If the supply is to be used in an application where the current drawn from the supply will not be essentially uniform with respect to time, then special notice should be taken of the action of the current regulating circuit. Since the current regulating circuit is set in such a fashion that normal performance of the supply does not exist when the output current is allowed to exceed 0.5 amperes (or some lower value, depending on the setting of the maximum current knob) and since the protection circuit must necessarily be a fast-acting circuit, it follows that the power supply will not perform properly if the output current is allowed to exceed 0.5 amperes for even a short interval. For example, if the load on the power supply consists of a class B amplifier which is drawing peak currents in excess of 0.5 amperes, it is quite possible that the protection circuit will begin to limit the output current even though the ammeter (which reads only average current) shows something less than 0.5 amperes out. The time required for the current controlling circuit to begin to cut off or limit the current through the series transistors is of the order of 50 to 100 microseconds. Therefore, if a load causes current in excess of 0.5 amperes to exist for a period longer than about 50 microseconds, the supply will not provide the desired current to this load and improper operation of the load device may result. The only solution to this problem, assuming that the nature of the load device cannot be changed, lies in the use of a supply having a higher current rating, since any transistorized regulated power supply will have to have a fast protection circuit if it is to protect the series transistors at all.

CIRCUIT DESCRIPTION *

Figure 7 is a block diagram of the 865B, while Figure 8 is a schematic of this same supply. Notice that the layout for the schematic and the block diagram have been made to correspond almost identically in order to facilitate an understanding of the circuit.

BLOCK DIAGRAM -- FIGURE 7

As shown in the block diagram, the power transformer provides power to three separate circuits--an auxiliary rectifier furnishing power for the bias and

reference supply, a second auxiliary rectifier used in conjunction with the operation of the series preregulator, and the main rectifier furnishing power through a series transistor regulator to the output terminals. There are two error amplifiers--one for voltage and one for current. The voltage error amplifier compares the output voltage with the voltage developed across the programming resistor and controls the series regulator so as to maintain the output voltage equal to the voltage across the programming resistor. The current error amplifier monitors the voltage drop across a current monitoring resistor, compares it to the reference and controls the series regulating transistor if the output current exceeds that for which it is set.

The first auxiliary rectifier circuit produces a positive and a negative bias voltage, both referenced to the negative output bus. These bias voltages are used at various points for the operation of the main regulator loop. In addition, the negative bias voltage is used as the input to a constant current reference regulator.

The action of the main feedback loop is such as to always hold the two input potentials to the error amplifier equal, therefore, voltage drop across resistor R is equal to the voltage drop across the reference voltage and is constant. Therefore, the current through resistor R must also be constant. This constant current flowing through the programming resistor determines the supply output voltage.

The constant current circuit is activated when the IR drop across a resistor in series with the negative output terminal reaches an adjustable threshold; at this point the series regulator in conjunction with the error amplifier acts as a constant current feedback loop and limits the output current to a value determined by the setting of the front panel knob.

SCHEMATIC -- FIGURE 8

The output from the fullwave rectifier D18-D19 develops a DC voltage across the input capacitor, C11. The output voltage is controlled by series power transistor, Q11. The entire output current, Io, passes through power transistor O11 and is controlled by the base current of this transistor which in turn is controlled by the base current of Q8. Likewise, the base current of O8 is controlled by the base current of Q3. In this manner a small base current controlling Q3 controls the main output current, Io. The ratio of a change in Io to a change in Ig is approximately 100,000 to 1. For example, a 5 microampere change in Ig would be sufficient to cause a 0.5 amp change in the output current, Io.

Figure 8 shows the transistor differential amplifier Q1 and Q2 used to control the transistor amplifier and series output transistor. The base of Q2 is maintained at the potential close to the negative output terminal while the base of O1 is connected through the programming resistor to the positive output terminal. The differential amplifier is so arranged that proper operating conditions occur when the base potentials of Q1 and Q2 are equal. If a current is passed from the positive

output terminal through the programming resistor, a voltage drop will exist between the base of Q1 and the positive output terminal which will be proportional to the current passing through this resistor. Since the base potentials of Q1 and Q2 must be equal, the output voltage will be equal to the IR drop across the programming resistor. In effect then, the differential amplifier consisting of Q1 and Q2 is comparing a reference voltage consisting of the IR drop from the positive output terminal to the base of Q1 with the output voltage.

The source of the reference voltage is a feedback amplifier similar to the main regulator. The output of the reference circuit is sensed by a resistive divider network--R21, R22, and R27--and compared with a reference voltage--the voltage across zener diode D12. Transistor Q7 is the reference voltage error detector and amplifier transistor. The amplified error signal is applied to the base of the reference voltage series transistor Q6 to maintain the reference voltage constant.

The constant current circuit involves transistors Q5, Q3, Q8, and Q11. This is a complete feedback loop but the voltage across R31 is monitored to get an indication of output current rather than the output voltage itself. As more and more current is supplied, transistor Q5 starts to turn on which in turn turns off Q1 thus transferring from constant voltage to constant current operation.

Transistors Q9 and Q10 together with their associated diodes and resistors act as preregulators for the main series transistors, thereby reducing the ripple input to the collector of Q8 and preventing the maximum dissipation in any power transistor from reaching a value which might lead to its damage.

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TROUBLE SHOOTING

NODAL CHECK

As an initial check, the following are nodal voltages as measured with a Simpson Model 269 multimeter or equivalent. Set line voltage at 117 volts, output voltage at 40V, and apply full load (i.e. 0.5A).

Voltage Measurement For Trouble Shooting

Medium Line E_{out} = 40V

I_{out} = .5A

+ to - Voltage Between	Voltage Reading	Comments
17 to 18	25V	±3V
17 to -S	6.5V	±10%
15 to -S	1.3V	±0.1V
-S to 16	9V	±5%
-S to 24	6.5V	±10%
24 to 27	.1V	±0.05V
16 to 25	1.3V	±.1V
23 to 36	2.4V	±.2V
-R to 36	1.5V	±0.1V @ full load
36 to 35	2V	±5%
11 to 36	0V	
32 to 36	0.7V	±.1V
36 to 33	0.34V	
13 to 33	0.2V	
14 to 13	2.8V	
15 to 14	0.2V	
37 to 35	42V	±1V
23 to 26	50V	
36 to 34	2.2V	±.1V
34 to 26	46V	±2V
37 to 12	42V	±2V
-S to 19	.2V	±.1V
30 to 31	95VAC	±3%
38 to 29	82VAC	±3%
21 to 22	38VAC	±3%
+S to 38	3V	±10%
37 to C11 (-)		±5%

INTERCHANGEABLE TRANSISTOR TYPES

Transistors used in this supply are not selected, but are of a "general purpose" type. The following transistors may be used.

Q1, Q2	2N1304, 2N445A, N272, 4JX15A713
Q3	2N1471, 2N1305, 2N520A, GT2555
Q4, Q5	2N1304, 2N445A, N272, 4JX15A713
Q6	2N1379
Q7	2N1471, 2N1305, 2N520A, GT2555
Q8	2N1304, 2N445A, N272
Q9, Q10	2N1137A, 2N459A
Q11	CTP1736

865B PARTS LIST

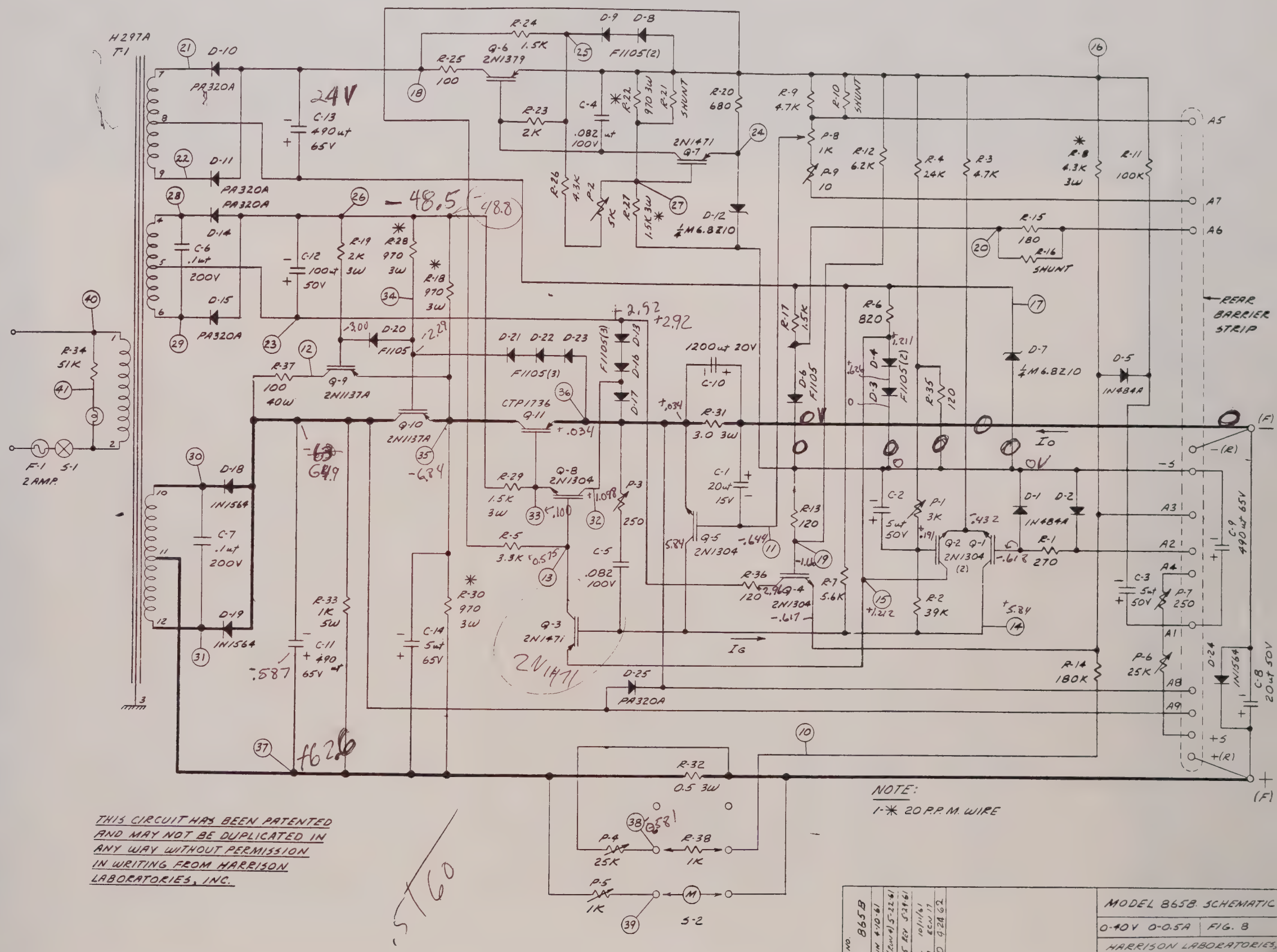
Circuit Symbol	Description	Code No.
T1	Transformer H397A	A
P1	Potentiometer 3K CTS Type 110	B1
P2	Potentiometer 5K CTS Type 110	B1
P3	Potentiometer 250 CTS Type 110	B1
P5	Potentiometer 1K CTS Type 110	B1
P4	Potentiometer 25K, CTS Series 70	B2
P6, 7	Potentiometer 25K, 250 Dual	B
P8, 9	Potentiometer 1K, 10 Dual	B
C1	Capacitor 20µf 15V	C
C8	" 20µf 50V	C
C2, 3	" 5µf 50V	C
C4, 5	" .082µf 100V	C
C6, 7	" 0.1µf 200V	C
C9, 11, 13	" 490µf 65V	C
C10	" 1200µf 20V	C
C12	" 100µf 50V	C
C14	" 5µf 65V	C
D3, 4, 6, 8, 9, 13, 16, 17, 20, 21, 22, 23	Diode F1105	E1
D10, 11, 14, 15, 25	Diode PA320A	E1
D7, 12	Diode 1/4M 6.8Z10	E6
D18, 19, 24	Diode 1N1564	E5
D1, 2, 5	Diode 1N484A	E1
Q1, 2, 4, 5, 8	Transistor N272 (2N1304)	E9, E4
Q3, 7	" 2N1471	E1
Q6	" 2N1379	E9
Q9, 10	" B1203 (2N1137A)	E9, T3
Q11	" CTP1736	K4
R1	Resistor 270 1/2W AB	F2
R2	" 39K 1/2W AB	F2
R7	" 5.6K 1/2W AB	F2
R4	" 24K 1/2W AB	F2
R5	" 3.3K 1/2W AB	F2
R6	" 820 1/2W AB	F2
R8	" 4.3K 3W SP	C
R3, 9	" 4.7K 1/2W AB	F2
R10	" Shunt 1/2W AB	F2
R11	" 100K 1/2W AB	F2
R12	" 6.2K 1/2W AB	F2

Circuit Symbol	Description	Code No.
R13, 35, 36	Resistor 120 1/2W AB	F2
R14	" 180K 1/2W AB	F2
R16	" Shunt 1/2W AB	F2
R17, 24	" 1.5K 1/2W AB	F2
R18, 22, 28, 30	" 970 3W SP	C
R19	" 2K 3W SP	C
R20	" 680 1/2W AB	F2
R21	" Shunt 1/2W AB	F2
R23	" 2K 1/2W AB	F2
R27, 29	" 1.5K 3W SP	C
R15	" 180 1/2W AB	F2
R31	" 3.0 3W WL Type 3X	F1
R32	" 0.5 3W WL Type 3X	F1
R33	" 1K 5W WL Type 5X	F1
R38	" 1K 1/2W AB	F2
R37	" 100 40W WL Type 817	F1
R34	" 51K 1/2W AB	F2
R26	" 4.3K 1/2W AB	F2
R25	" 100 1/2W AB	F2
F1	Fuse 2 amp 3AG	P11
S1	Switch on-off Carling 2BL63-73	J1
S2	Switch Trolex #865BS2	J2
	Transistor Socket Elco 3305	
	Mica Insul. Washer Diamond	
	Mica Insul. Washer Clevite "Space Saver"	
	Barrier Strip Kulka #600-YSY-13	
	Jumper Kulka #600J	

*Note: All resistors ±5% unless otherwise specified.
All non-electrolytic capacitors ±10%.
All electrolytic capacitors +100% -80%.

SUPPLIER'S CODE

A	Cycle Transformer Corp. 356 Glenwood Avenue East Orange, New Jersey
B	CTS of Ashville, Inc. Mills Gap Road Skyland, North Carolina
B1	CTS of Berne, Inc. 406 Parr Road Berne, Indiana
B2	CTS Corporation c/o H. L. Slough 5 Haddon Avenue Haddonfield, New Jersey
C	Sprague Electric Co. 50 East 41st Street New York 17, New York
D	Arco Electronics, Inc. Community Drive Great Neck, New York
E1	General Instrument Corp. Semiconductor Division 65 Gouverneur Street Newark 4, New Jersey
E2	Standard Rectifier Corp. c/o D. R. Bittan Co. 104 South Central Avenue Valley Stream, L.I., New York
E3	Transitron Electronic Corp. 1060 Broad Street Newark 2, New Jersey
E4	General Electric Co. 200 Main Avenue Clifton, New Jersey
E5	Motorola, Inc. Styertowne Bldg. 1051 Bloomfield Avenue Clifton, New Jersey
E6	Hoffman Electronics Corp. 100 Menlo Park, Suite 209 Metuchen, New Jersey Att: Mr. Arthur L. Nelson (Semiconductor Division)
E7	U. S. Semiconductor Products 3540 West Osborn Road Phoenix, Arizona
E8	Radio Corporation of America Semiconductor & Materials Division Customers Service Somerville, New Jersey
E9	Texas Instruments Inc. 1141 East Jersey Street Elizabeth, New Jersey
E10	Sylvania Electric Products 1000 Huyler Street Teterboro, New Jersey
E11	Hewlett-Packard Company 1501 Page Mill Road Palo Alto, California
F	Hardwick Hindle, Inc. 40 Hermon Street Newark 5, New Jersey
F1	Ward Leonard Electric Co. P. O. Box 631 Bloomfield, New Jersey
F2	Allen-Bradley Company 630 Third Avenue New York 17, New York
G	Victory Engineering Corp. 42 Springfield Road Union, New Jersey
H	Hoyt Electrical Inst. Works, Inc. 42 Carleton Street Cambridge, Massachusetts



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8658	
TOB NO.	
DRAWN	4-10-61
REV(Zener)	5-22-61
REV	5-31-61
REV. C	10/11/61
REV.	ECN 17
REVD	9-24-62

MODEL 8658 SCHEMATIC

0-40V 0-0.5A | FIG. 8

HARRISON LABORATORIES, INC.
BERKELEY HEIGHTS, N.J.

P1 Kulka Electric Mfg. Co.
c/o Adolph Friedman Co.
519 South Fifth Avenue
Mt. Vernon, New York

P2 James Millen Mfg. Co., Inc.
150 Exchange Street
Malden, Massachusetts

P3 Bud Radio, Inc.
2118 East 55th Street
Cleveland 3, Ohio

P4 U. S. Rubber Co.
c/o Barry Controls, Inc.
Industrial Division
700 Pleasant Street
Watertown, Massachusetts

P5 Sanborn Company
195 Massachusetts Avenue
Cambridge 39, Massachusetts

P6 Herman H. Smith
2326 Nostrand Avenue
Brooklyn 10, New York

P7 Transistor Electronics Corp.
3357 Republic Avenue
Minneapolis 26, Minnesota

P8 Industrial Devices Inc.
982 River Road
Edgewater, New Jersey

P9 Eldema Corp.
1805 Belcroft Avenue
El Monte, California

P10 U.S. Engineering Co.
456 Sylvan Avenue
Englewood Cliffs, New Jersey

P11 Jobber items

P12 Philadelphia Handle Co.
1643 Haddon Avenue
Camden 3, New Jersey

P13 Heyman Mfg. Company
Kenilworth, New Jersey

P14 Cornish Wire Company
50 Church Street
New York 7, New York

P15 Belden Mfg. Company
P. O. Box 5070A
Chicago 80, Illinois

P16 Littlefuse
c/o Jules J. Bressler
4808 Bergenline Avenue
Union City, New Jersey

P17 Bussmann Mfg. Co.
University & Jefferson
St. Louis 7, Missouri

P18 Whitso, Inc.
9330 Byron Street
Schiller Park, Illinois

P19 Amphenol Eastern Connector Div.
Fair Lawn Industrial Park
Fair Lawn, New Jersey

P20 Electrical Industries
Murray Hill, New Jersey

P1 DC Output Impedance Adjust

Set power supply output voltage to maximum rated output voltage. Connect differential voltmeter or digital voltmeter directly across the rear sensing terminals (+S and -S) and load directly to the rear output terminals (- and +). P1 should be adjusted so that the output voltage remains constant for a change in output load from no load to full load. During this check, it is very important that the current limit control should be set fully clockwise so that there will be no tendency of the supply to approach its current limit operating point.

P2 Line Voltage Adjustment

Set power supply output voltage to maximum rated output voltage. Connect a differential voltmeter or digital voltmeter across the reference voltage supply--point -S (+) and 16 (-). P2 is adjusted so that the reference voltage change is minimized as the input line voltage is varied from 105 to 125 volts.

P3 Transient Response Adjust

Set power supply output voltage to a low voltage (2 to 4 volts). Connect a fast-acting switch in series with a non-inductive load. The load current should be the maximum rated load current of the power supply. A suitable switch is a mercury wetted relay such as Clare relay Type HGP1002. Connect an oscilloscope across the sensing terminals.

Adjust P3 so that the decay of the transient spike is a smooth exponential curve without overshoot, undershoot, or ringing in both the loading and unloading transient.

P4 Voltmeter Calibrating Adjust

P4 is adjusted so that the voltmeter (after being properly zeroed) reads correctly at a full-scale or near full-scale value. Comparison should be made with a precision voltmeter connected directly across the output terminals.

P5 Ammeter Calibrating Adjust

A fixed load resistor capable of drawing approximately full load current from the supply should be connected to the output terminals. A precision ammeter (or precision resistor shunted by precision voltmeter) should be connected in series

with this load. P5 is then adjusted until front panel ammeter reads the same as the reference meter.

P6 Fine Voltage Adjust

This is the front panel fine output voltage control.

P7 Coarse Voltage Adjust

This is the front panel coarse output voltage control.

P8 Coarse Current Adjust

This is the front panel coarse output current control.

P9 Fine Current Adjust

This is the front panel fine output current control.

Shunts

R10 R10 is adjusted so that the maximum short circuit current is 1.6 amps. For this adjustment potentiometer P8 is set fully clockwise.

R16 R16 is adjusted so that the output current goes to zero when P8 is fully counterclockwise.

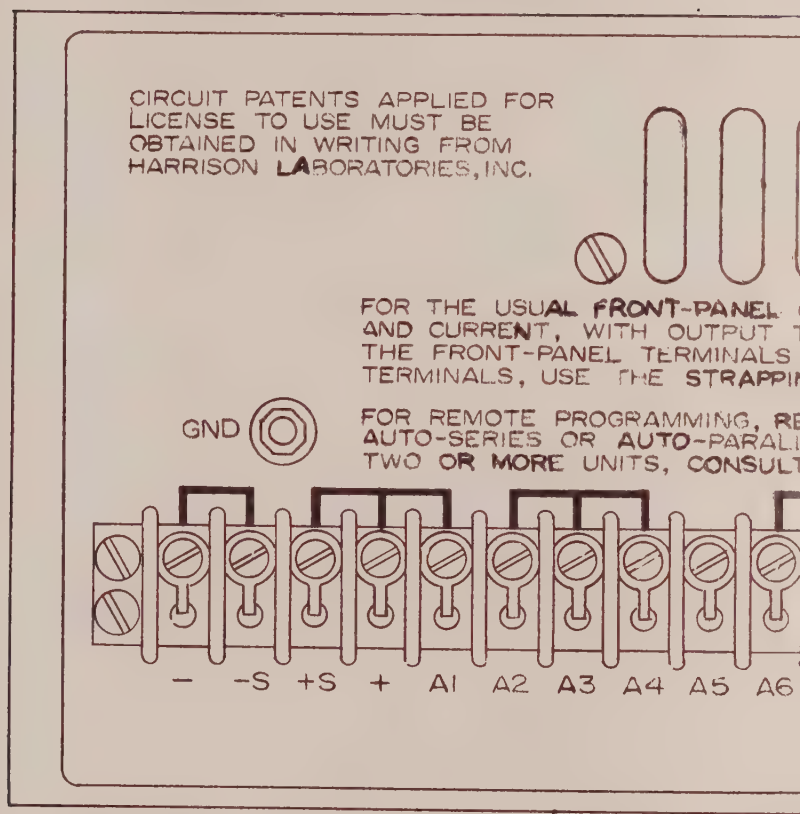
R21 Reference Voltage Adjust. This resistor is adjusted so that the output voltage will be 18 volts $\pm$5% when a 9V $\pm$1% resistor is placed across the remote programming terminals. (+S and A2--strap between A3 and A4 removed.)

INSTALLATION OF MODELS 855B AND/OR 865B POWER SUPPLIES IN RACK MOUNTING PANELS R-855/865-1B AND R-855/865-2B.

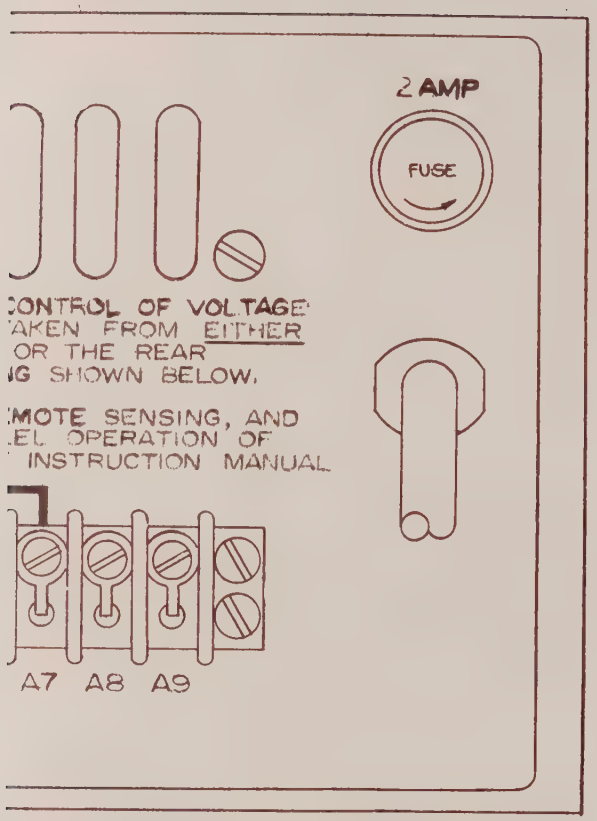
1. Remove the top and bottom cover plates from the 855B or 865B power supply.

2. Put the supply through the hole in the rack mounting panel, inserting the power cord through the hole first.

3. Replace the top and bottom panels on the 855B or 865B power supply in an inverted position. That is, the cover panels should now have the front lip pointing away from the power supply (instead of into the power supply). Tighten these cover panels down using the original screws which held the cover panels to the power supply. The rack panel will thus be held snugly between the back of the front panel of the power supply and the front lip of the cover plate for the supply.

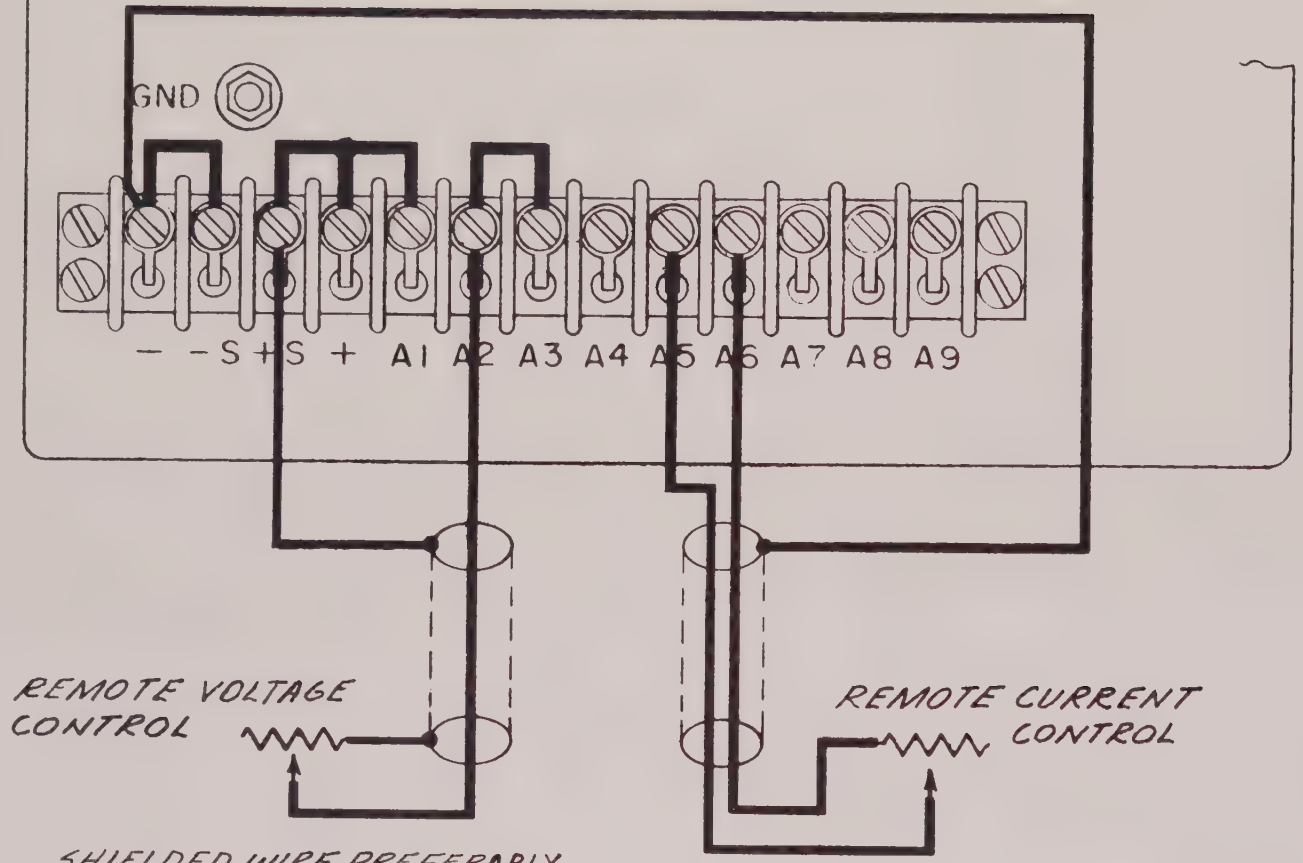

CIRCUIT PATENTS APPLIED FOR
LICENSE TO USE MUST BE
OBTAINED IN WRITING FROM
HARRISON LABORATORIES, INC.
FOR THE USUAL FRONT-PANEL
AND CURRENT, WITH OUTPUT
THE FRONT-PANEL TERMINALS
TERMINALS, USE THE STRAPPI
GND
FOR REMOTE PROGRAMMING, RE
AUTO-SERIES OR AUTO-PARALL
TWO OR MORE UNITS, CONSULT
— -S +S + A1 A2 A3 A4 A5 A6

REAR VIEW OF INSTRUMENT SH
OF REAR BARRIER STRIP FOR F
VOLTAGE, CURRENT AND LOCAL S
OR REAR OUTPUT TERMINALS



OWING NORMAL CONNECTIONS
ONT PANEL CONTROL OF
ENSING FOR EITHER FRONT

JOB NO 855B 865B	DWN 12-20-60	TITLE NORMAL CONNECTIONS
		FOR MODEL 855B-865B
		FIG 1


GND
– – S + S + A1 A2 A3 A4 A5 A6 A7 A8 A9
REMOTE VOLTAGE CONTROL
REMOTE CURRENT CONTROL
SHIELDED WIRE PREFERABLY. NOT NECESSARY IF LENGTH IS REASONABLE SHORT

REAR TERMINAL CONNECTIONS FOR REMOTE PROGRAMMING OF OUTPUT VOLTAGE AND OUTPUT CURRENT (LOCAL SENSING)

TDB NO. 8558, 8658	DWN 2-24-61	TITLE: REMOTE PROGRAMMING
		MODEL 855B, 865B — FIG. 2
		HARRISON LABS., INC. BERKELEY HEIGHTS, NJ

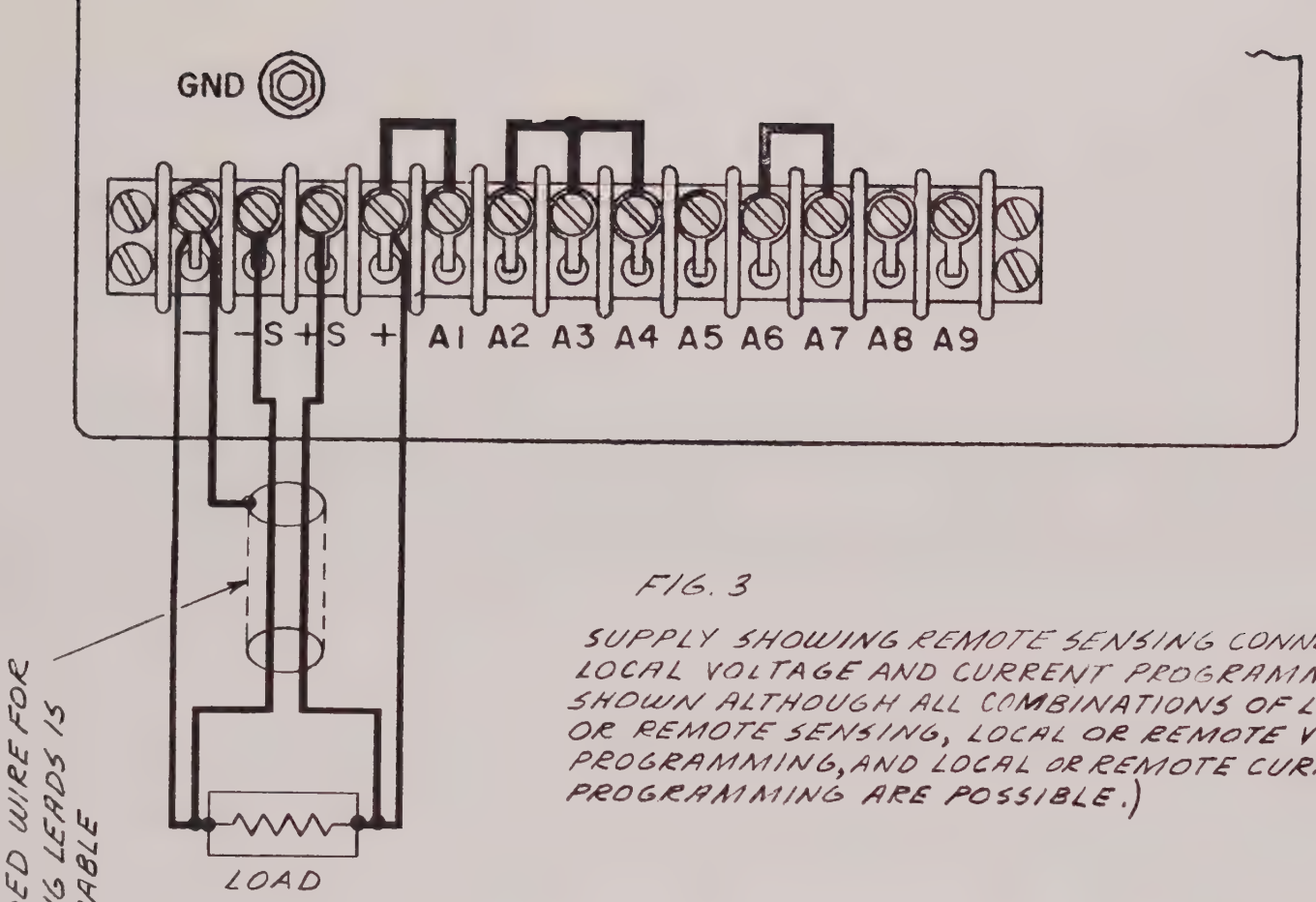
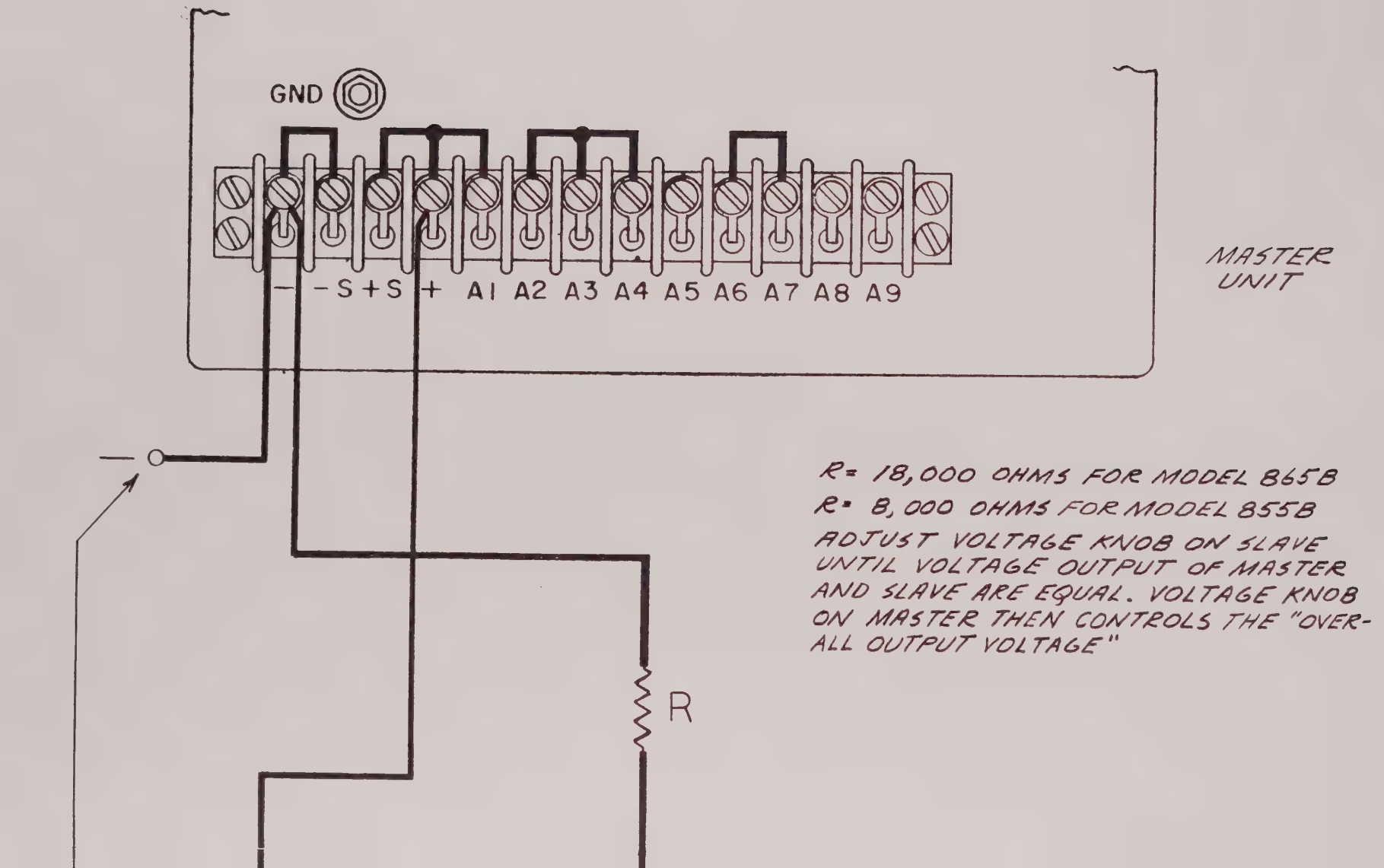


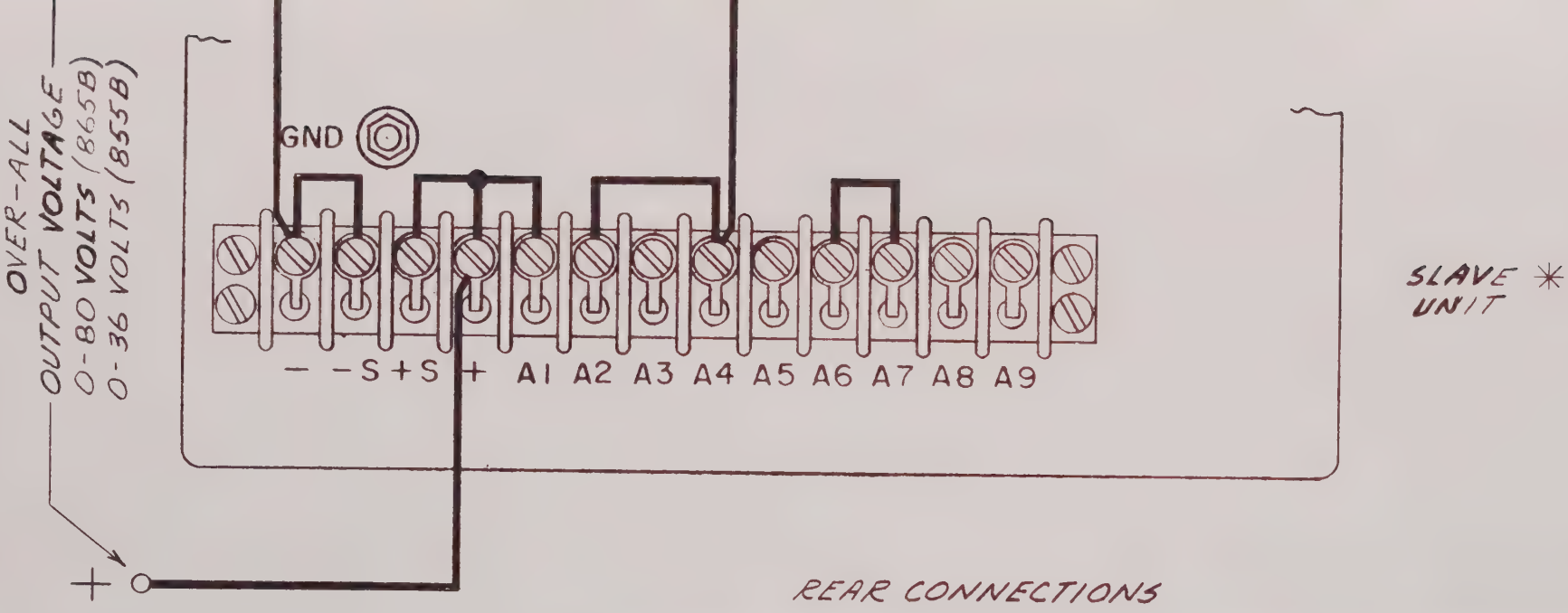
FIG. 3

SUPPLY SHOWING REMOTE SENSING CONNECTIONS. (NOTE: LOCAL VOLTAGE AND CURRENT PROGRAMMING IS SHOWN ALTHOUGH ALL COMBINATIONS OF LOCAL OR REMOTE SENSING, LOCAL OR REMOTE VOLTAGE PROGRAMMING, AND LOCAL OR REMOTE CURRENT PROGRAMMING ARE POSSIBLE.)

JOB NO. 855B, 865B		TITLE REMOTE SENSING CONNECTIONS
DWN. 2-23-61		MODEL 855B, 865B — FIG. 3
		HARRISON LABS., INC. BERKELEY HEIGHTS, NJ



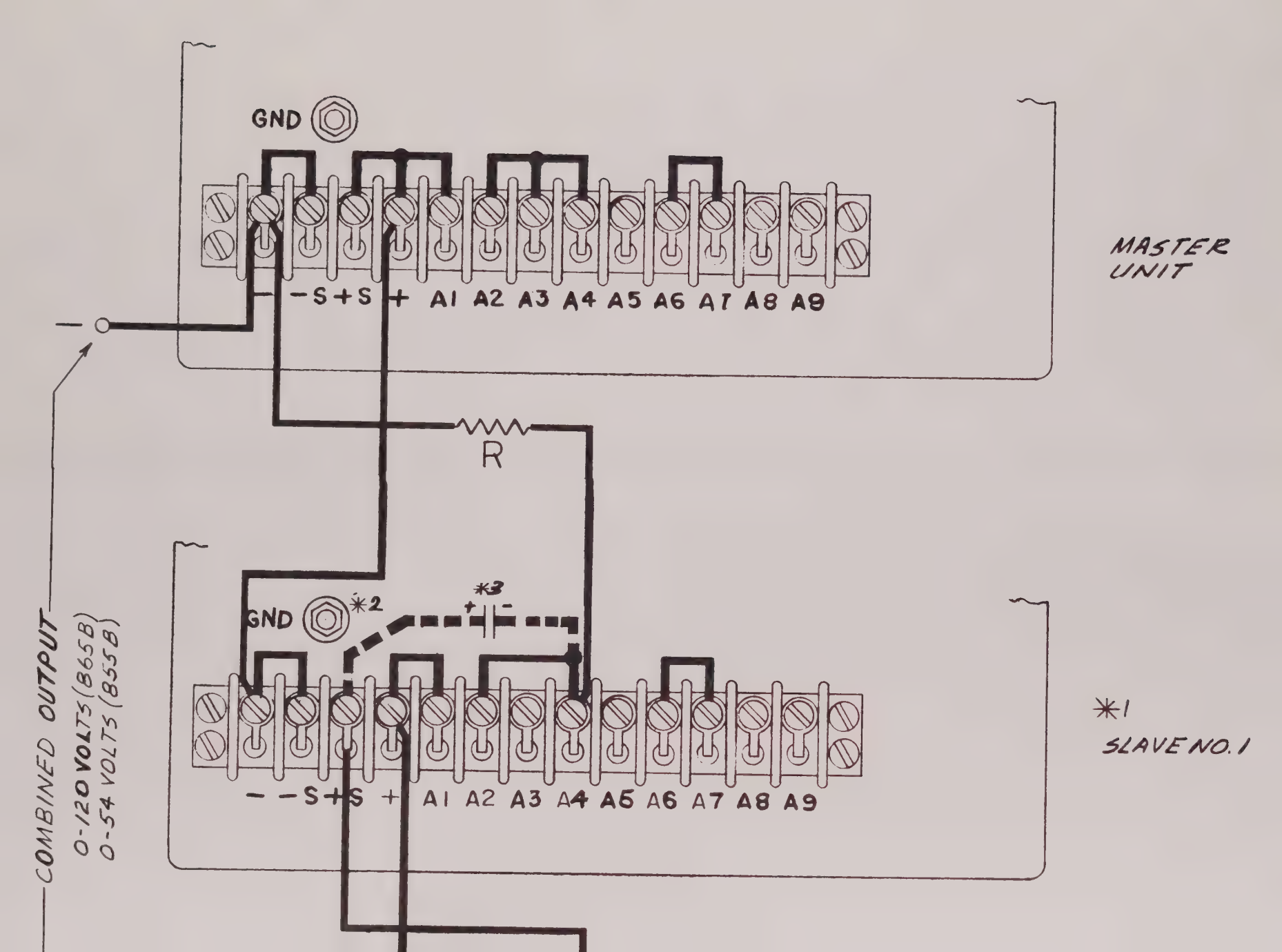
R= 18,000 OHMS FOR MODEL 865B
R= 8,000 OHMS FOR MODEL 855B
ADJUST VOLTAGE KNOB ON SLAVE UNTIL VOLTAGE OUTPUT OF MASTER AND SLAVE ARE EQUAL. VOLTAGE KNOB ON MASTER THEN CONTROLS THE "OVER-ALL OUTPUT VOLTAGE"

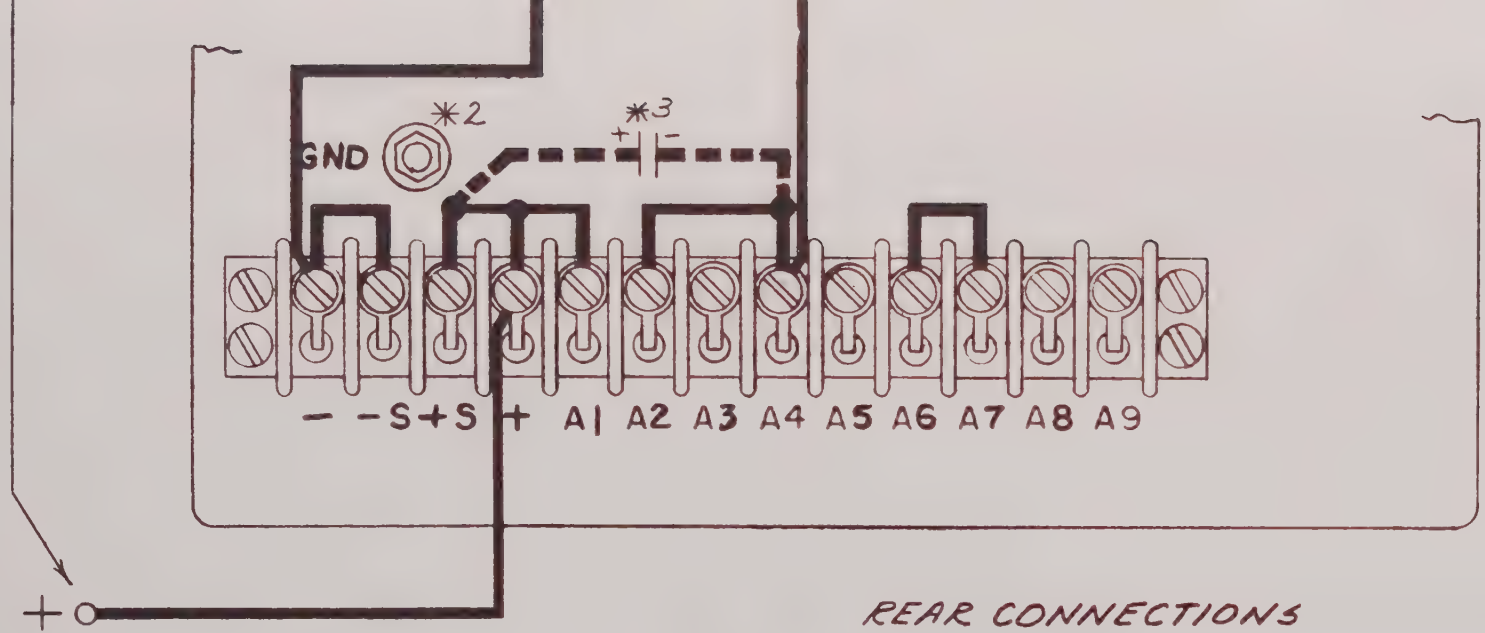


REAR CONNECTIONS

✳ THE SLAVE UNIT IS A UNIT IDENTICAL WITH THE MASTER UNIT EXCEPT FOR THE INDICATED CHANGE IN REAR CONNECTIONS.

TOB NO. 8558, 8658	DWN 2-24-61	TITLE SERIES OPERATION OF TWO UNITS
		MODEL 8558, 8658 — FIG. 4
		HARRISON LABS., INC. BERKELEY HEIGHTS, NJ


GND
- -S +S + A1 A2 A3 A4 A5 A6 A7 A8 A9
MASTER UNIT
R
GND
*2
*3
+
-
- -S +S + A1 A2 A3 A4 A5 A6 A7 A8 A9
*1
SLAVE NO. 1
COMBINED OUTPUT
0-120 VOLTS (865B)
0-54 VOLTS (855B)



REAR CONNECTIONS

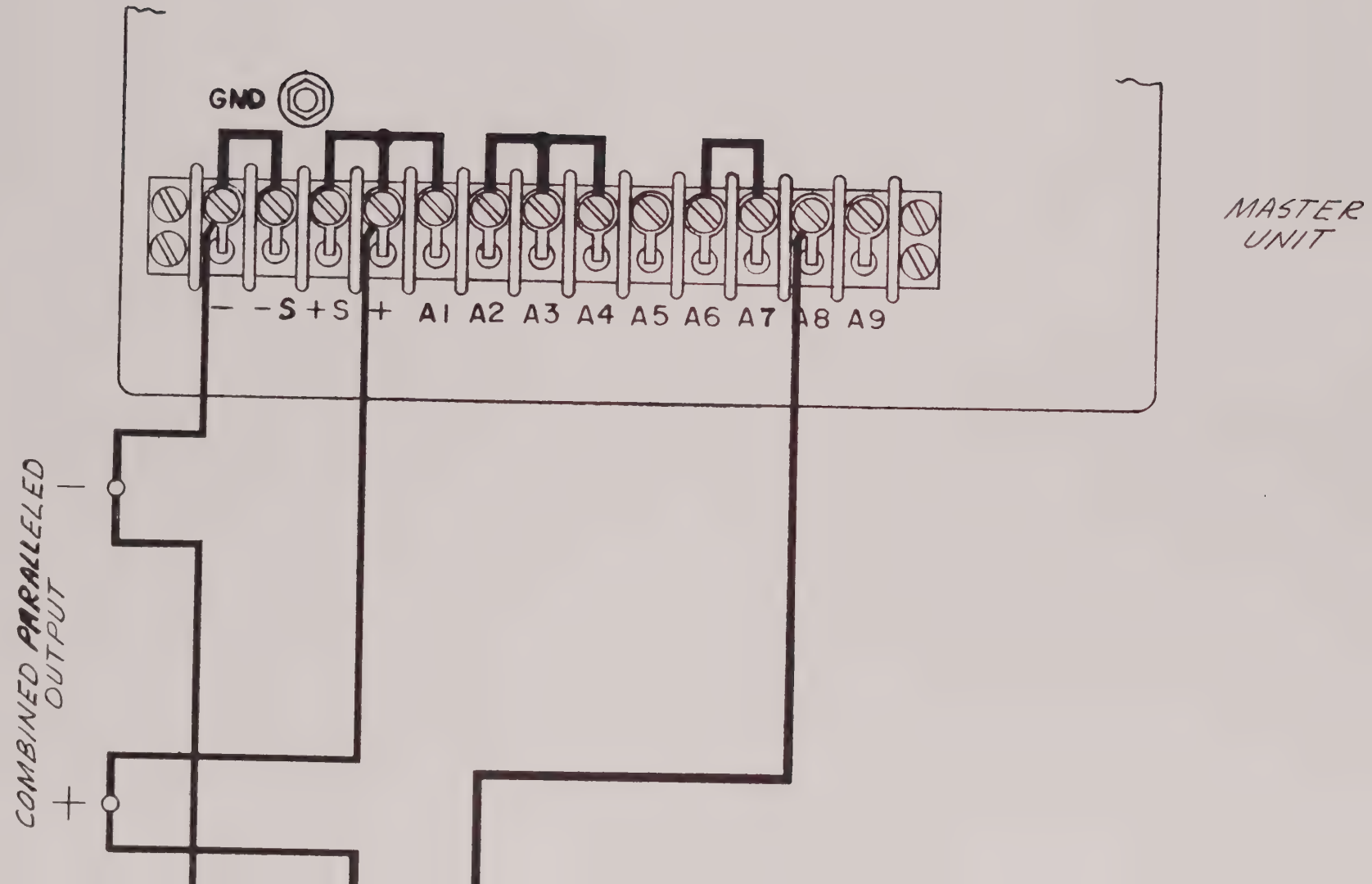
✳1 THE SLAVE UNIT IS A UNIT IDENTICAL WITH THE MASTER UNIT EXCEPT FOR THE INDICATED CHANGE IN REAR CONNECTIONS

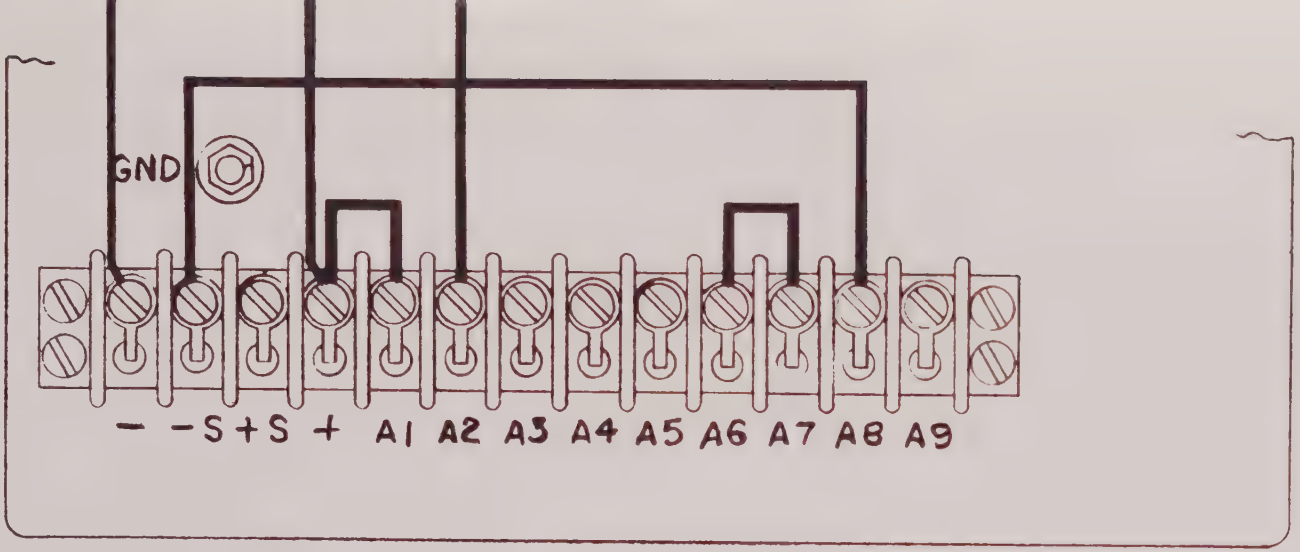
✳2 THE CHASSIS POTENTIAL TO EITHER THE(+) OR (−) OUTPUT TERMINAL SHOULD NOT EXCEED 200 VOLTS. FROM THIS WE CAN CONCLUDE: (a)- IF TWO TO FOUR UNITS ARE TO BE SERIESED **THEN THE GND. TERMINALS OF EACH UNIT** CAN BE CONNECTED DIRECTLY TO THE (+) OR (−) OF THE COMBINED OUTPUT. (b)- IF FIVE OR MORE ARE TO BE SERIESED, THEN THE INDIVIDUAL CHASSIS SHOULD BE CONNECTOR TO EITHER THE (+) OR (−) TERMINAL OF THEIR OWN OUTPUT. IN THIS CASE THE POWER CORD GND. WIRE (GREEN LEAD) MUST BE BROKEN OTHERWISE THE CHASSIS ARE CONNECTED TO EACH OTHER THROUGH THE GND. ASSOCIATED WITH THE POWER LINE.

R = 8,000 OHMS ON MODEL 855B
R = 18,000 OHMS ON MODEL 865B
ADJUST VOLTAGE KNOB ON SLAVES UNTIL VOLTAGE OUTPUT OF MASTER AND SLAVES ARE EQUAL. VOLTAGE KNOB ON MASTER THEN CONTROLS THE "COMBINED OUTPUT VOLTAGE".

✳3 FOR MINIMUM RIPPLE ACROSS SERIESED OUTPUTS ADD A 5μf OR LARGER (50V ELECTROLYTIC) FROM (+S) TO (A4) TERMINALS ON ALL SLAVE UNITS.

JOB NO. 855B, 865B	
DWN. 2-24-61	
REV. 5-12-61	
TITLE: SERIES OPERATION OF THREE (3) UNITS	
MODEL 855B, 865B	FIG. 5
HARRISON LABS., INC. BERKELEY HEIGHTS, NJ	


GND
– –S +S + A1 A2 A3 A4 A5 A6 A7 A8 A9
MASTER UNIT
COMBINED PARALLELED OUTPUT
–
+



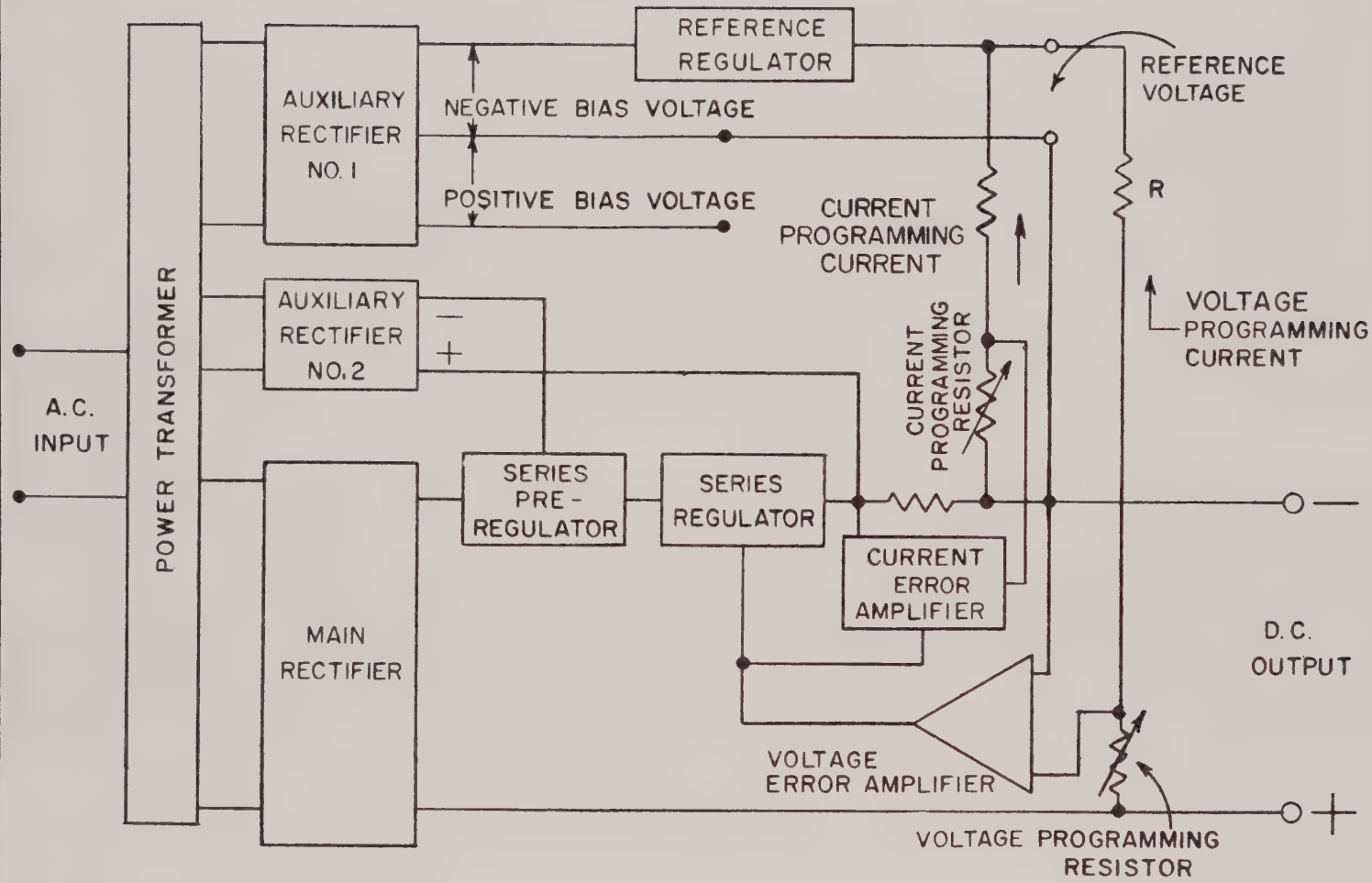
SLAVE ✳ UNIT

REAR CONNECTIONS

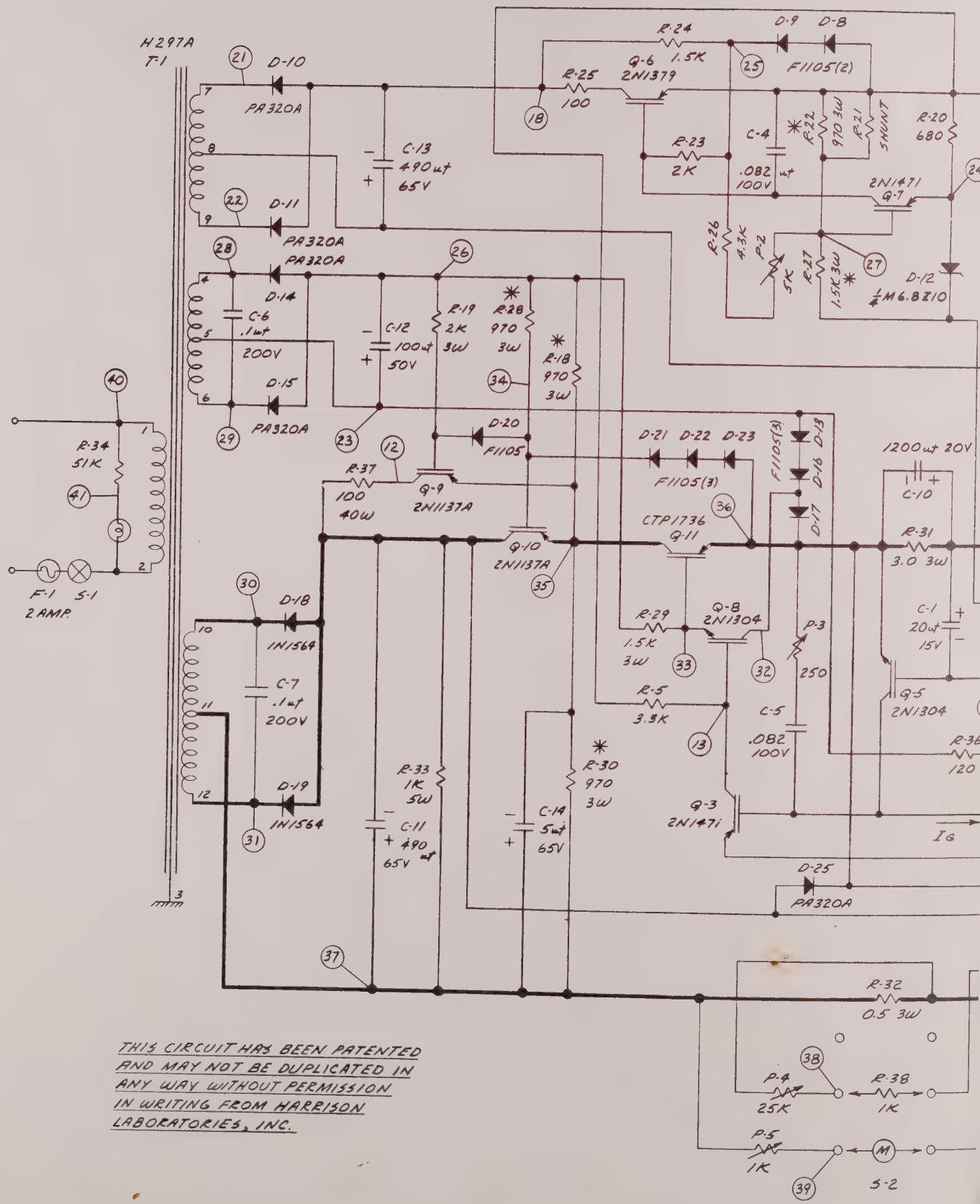
✳ THE SLAVE UNIT IS A UNIT IDENTICAL WITH THE MASTER UNIT EXCEPT FOR THE INDICATED CHANGE IN REAR CONNECTIONS.

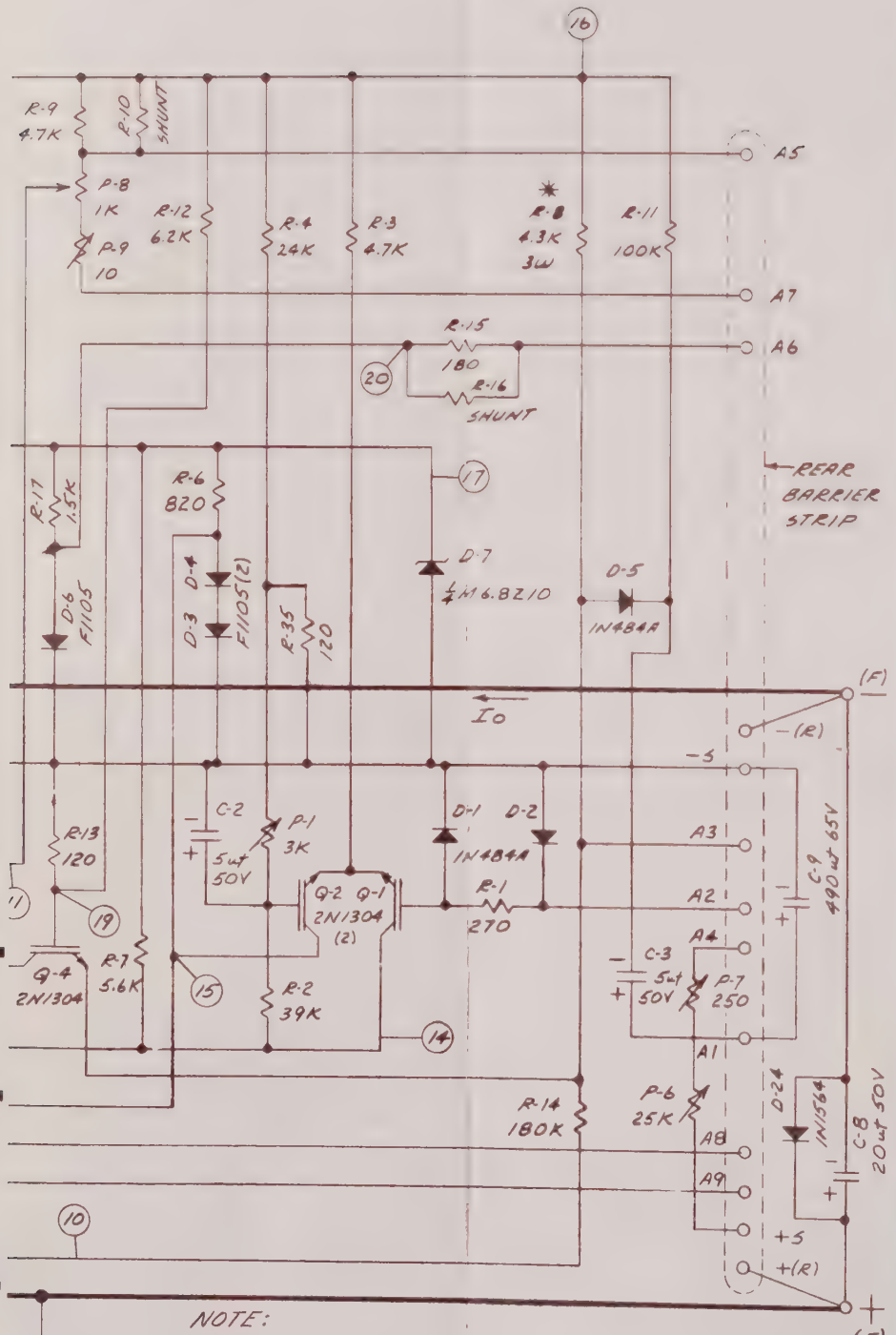
JOB NO. 8558, 8658		TITLE PARALLEL OPERATION
DWN 2-24-61		MODEL 8558, 8658 — FIG. 6
		HARRISON LABS., INC. BERKELEY HEIGHTS, NJ

JOB NO. 8558 8658
5-4-60
2-24-61



HARRISON LABORATORIES, INC.
45 INDUSTRIAL ROAD
BERKELEY HEIGHTS, N. J.
FIG-7
TITLE MODEL 8658, 8558
BLOCK DIAGRAM


H297A
T-1
D-10
PA320A
C-13
490 uf
65V
D-11
PA320A
D-14
C-6
.1 uf
200V
D-15
PA320A
C-12
100 uf
50V
R-19
2K
3W
R-28
970
3W
R-18
970
3W
D-20
F1105
R-24
1.5K
Q-6
2N1379
R-25
100
D-9
D-8
F1105(2)
R-23
2K
C-4
.082 uf
100V
R-22
970 3W
R-21
SHUNT
R-20
680
2N1471
Q-7
R-26
4.3K
R-2
5K
R-27
1.5K 3W
D-12
1/4M6.8Z10
R-34
51K
F-1
2 AMP.
S-1
R-37
100
40W
Q-9
2N1137A
Q-10
2N1137A
D-21
D-22
D-23
F1105(3)
F1105(3)
D-18
D-17
D-16
D-13
CTP1736
Q-11
1200 uf 20V
C-10
R-31
3.0 3W
C-1
20 uf
15V
Q-5
2N1304
R-29
1.5K
3W
Q-8
2N1304
P-3
250
R-5
3.9K
C-5
.082
100V
R-36
120
D-18
IN1564
C-7
.1 uf
200V
D-19
IN1564
R-33
1K
5W
C-11
490 uf
65V
R-30
970
3W
C-14
5 uf
65V
Q-3
2N1471
IG
D-25
PA320A
R-32
0.5 3W
P-4
25K
R-38
1K
P-5
1K
M
S-2
THIS CIRCUIT HAS BEEN PATENTED AND MAY NOT BE DUPLICATED IN ANY WAY WITHOUT PERMISSION IN WRITING FROM HARRISON LABORATORIES, INC.



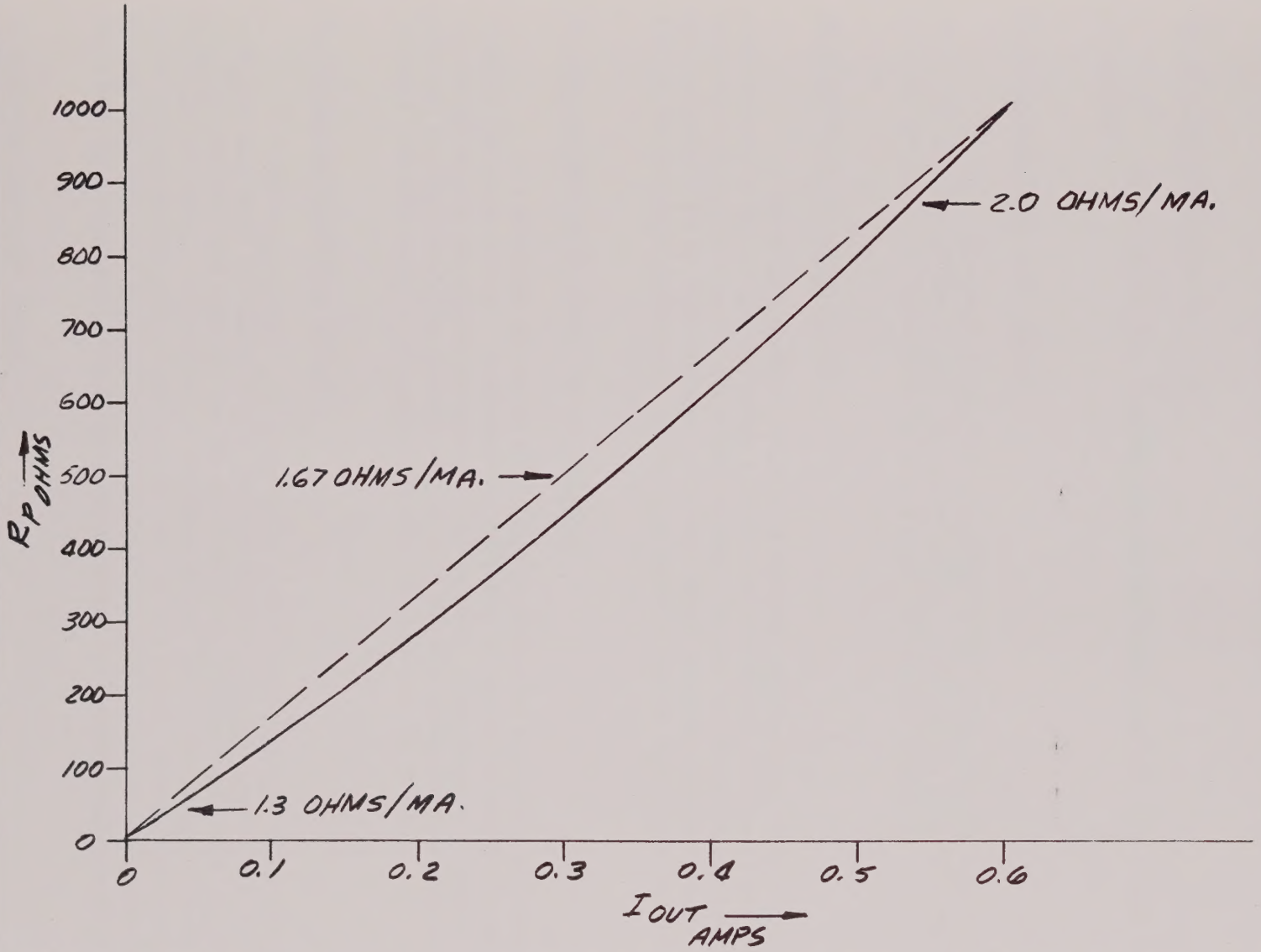
JOB NO.	865B
DRAWN	4-10-61
REVISED	5-22-61
REVISED	5-29-61
REV C	10/11/61
REV D	ECN 17 4-24-62

MODEL 865B SCHEMATIC

0-40V 0-0.5A | FIG. 8

HARRISON LABORATORIES, INC.
BERKELEY HEIGHTS, N.J.

865B



865B TYPICAL CONSTANT CURRENT PROGRAMMING CHARACTERISTIC.

SHEET 1 OF 1

HARRISON LABORATORIES, INC.
45 INDUSTRIAL ROAD
BERKELEY HEIGHTS, N. J.

TITLE 1100EL 865B

FIG. 9

855B/865B Alignment Procedure

P6, P7, P8, P9 Output Controls

These are output controls and are not concerned with the alignment procedure.

P4 Voltmeter Calibrating Adjust

P4 is adjusted so that the voltmeter (after being properly zeroed) reads correctly at a full-scale or near full-scale value. Comparison should be made with a precision voltmeter connected directly across the output terminals.

P5 Ammeter Calibrating Adjust

A fixed load resistor capable of drawing approximately full load current from the supply should be connected to the output terminals. In series with this load a precision ammeter (or precision resistor shunted by precision voltmeter) should be connected. P5 is then adjusted until front panel ammeter reading coincides with that of the precision monitoring device connected in series with the output load.

P2 Null Adjustment for Line Voltage Changes

A variac and precision AC voltmeter should be connected into line cord feeding the power supply. A differential voltmeter or digital voltmeter should be connected across the output terminals of the supply. After warmup P2 should be adjusted so that the output voltage change is minimized when the line voltage is changed from 105 volts to 125 volts and from 125 volts to 105 volts.

P1 DC Output Impedance Adjust

With the supply set for maximum rated output voltage, the differential voltmeter or digital voltmeter should next be attached directly across the rear sensing terminals (+S and -S) and the load attached directly to the rear output terminals (- and +). P1 should be adjusted so that the output voltage remains constant for a change in output load from no load to 0.5 amps. During this check, it is very important that the current limit control should be set fully clockwise so that there will be no tendency of the supply to approach its current limit operating point.

P3 Transient Response Adjust

The supply should next be set for a low output voltage (at full load current) with a low input line voltage (105-110VAC). A mercury wetted relay (or